





Exhibit 5


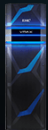


CHART FOR U.S. PATENT NO. 8,285,961 (“the ’961 Patent”)**Accused Products:**

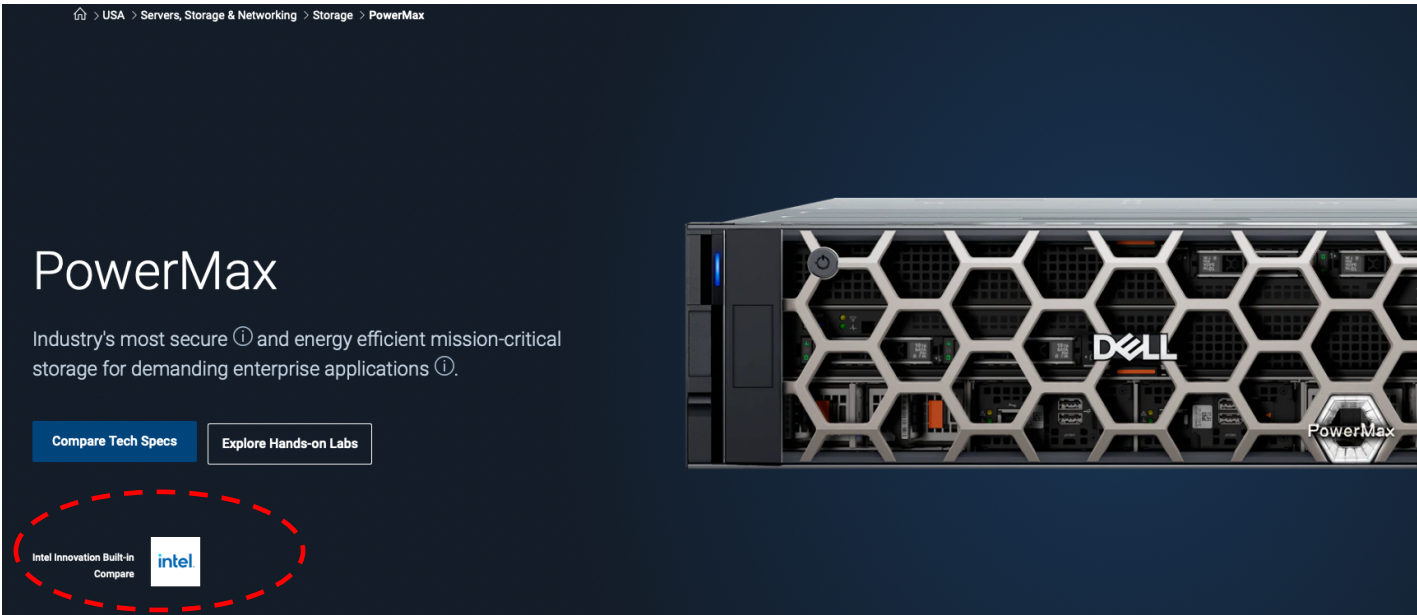
Dell’s products, including but not limited to Dell’s PowerMax (*e.g.*, PowerMax 2000, 2500, 8000, and 8500), VMAX All Flash (*e.g.*, VMAX 250F, 450F, 850F, and 950F), and EMC VMAX (*e.g.*, VMAX 100K, 200K, and 400K) products with “Fully Automated Storage Tiering (FAST)” functionality (“Accused Products”), infringe at least Claim 1 of the ’961 Patent.

Claims	Exemplary Evidence of Infringement
1 [pre] An apparatus, comprising	<p>To the extent the preamble is limiting, the Accused Products comprise an apparatus.</p> <p>For example, the Accused Products comprise “modular storage components for compute and storage media” where the “compute modules are packaged as node pairs . . . [and e]ach node pair contains two PowerMax compute nodes, complete software and licensing.”</p> <p><i>See, e.g.:</i></p>

Claims	Exemplary Evidence of Infringement						
	MODELS	WORKLOAD DATA TYPE	RESPONSE TIMES (LOWER IS BETTER) ⓪	CAPACITY PER ARRAY	DATA REDUCTION GUARANTEE ⓪	NODES PER ARRAY (FOR SCALEOUT)	MAX NUMBER OF DEVICES / SECURE SNAPSHOTS
	 PowerMax 2000	Block, file, IBM i, virtualized applications	Under 100 microseconds	13 TBu - 1.2 PBe	3.5:1 data reduction (Open)	2-4 controllers	64K LUNs / 65M snapshots Contact Sales View Spec Sheet
	 PowerMax 2500	Open systems, mainframe, IBM i, file, virtualized applications	Under 60 microseconds	13 TBu - 8 PBe	5:1 data reduction (Open); 3:1 data reduction (Mainframe)	2-4 nodes	64K LUNs / 65M snapshots Contact Sales View Spec Sheet
	 PowerMax 8000	Open systems, mainframe, IBM i, file, virtualized applications	Under 100 microseconds	54 TBu - 4.5 PBe	3.5:1 data reduction (Open)	2-16 controllers	64K LUNs / 65M snapshots Contact Sales View Spec Sheet
	 PowerMax 8500	Open systems, mainframe, IBM i, file, virtualized applications	Under 60 microseconds	13 TBu - 18 PBe	5:1 data reduction (Open); 3:1 data reduction (Mainframe)	2-16 nodes	64K LUNs / 65M snapshots Contact Sales View Spec Sheet
<u>Servers, Storage & Networking – Storage – PowerMax</u> <u>PowerMax is built from modular storage components for compute and storage media. The compute modules are packaged as node pairs. Each node pair contains two PowerMax compute nodes, complete software and licensing, cache memory, redundant power, and connectivity modules. These are combined with 48-slot Dynamic Media Enclosures (DMEs) to configure NVMe flash drives. PowerMax arrays are delivered with the Inclusive Software package. NVMe drive capacity can be added to the system to scale up to a total effective capacity of 8 PBe on the PowerMax 2500 and up to 18 PBe on the PowerMax 8500.</u> <u>Specification Sheet – Dell PowerMax Array – DELL POWERMAX – Dell PowerMax 2500 and 8500</u>							

Claims	Exemplary Evidence of Infringement
	<p><u>Unisphere enables you to configure and manage PowerMax, VMAX All Flash, and VMAX storage systems.</u></p> <p>Unisphere is a HTML5 web-based application that enables you to configure and manage <u>PowerMax, VMAX All Flash, and VMAX storage systems.</u> The term Unisphere incorporates "Unisphere for PowerMax" for the management of PowerMax and All Flash storage systems running PowerMaxOS 5978, and "Unisphere for VMAX" for the management of VMAX All Flash and VMAX storage systems running HYPERMAX OS 5977 and Enginuity OS 5876.</p> <p>Blog posts and videos that provide an overview of Unisphere functionality can be accessed by clicking here.</p> <p><u>Service Levels management - A service level is the response time target for a storage group. The service level sets the storage array with the required response time target for a storage group. It automatically monitors and adapts to the workload needed maintain the response time target.</u> The service level includes an optional workload type so it can be optimized to meet performance levels.</p> <p>Templates management - Using the configuration and performance characteristics of an existing storage group as a starting point, you can create templates that will prepopulate fields in the provisioning wizard and create a more realistic performance reservation in your future provisioning requests.</p> <p>Storage Resource Pools management - <u>Fully Automated Storage Tiering (FAST) provides automated management of storage array disk resources to achieve expected service levels.</u> FAST automatically configures disk groups to form a Storage Resource Pool (SRP) by creating thin pools according to each individual disk technology, capacity, and RAID type.</p> <p>Dell EMC Unisphere for PowerMax Product Guide</p>

Claims	Exemplary Evidence of Infringement
	<div data-bbox="411 232 1843 678"> <p>Products > Data Storage > VMAX All Flash</p>  <p>EMC VMAX All Flash Storage</p> <p>Intel® Xeon® Scalable Processors</p> <p>intel xeon PLATINUM</p> </div> <p>Data Storage – VMAX All Flash</p> <div data-bbox="411 743 1833 1258"> <p>« Storage EMC VMAX</p> <p>EMC VMAX³ AUTOMATE. MODERNIZE. CONSOLIDATE.</p> <p>Automate service level delivery. Modernize the data center. Consolidate critical systems. Deliver more on a trusted enterprise data services platform.</p> <div>  <p>Entry Point Up to 500 TB Capacity EMC VMAX 100K more ></p> </div> <div>  <p>Ultimate Versatility Up to 2 PB Capacity EMC VMAX 200K more ></p> </div> <div>  <p>The Ultimate Consolidator Up to 4 PB Capacity EMC VMAX 400K more ></p> </div> </div> <p>Storage – EMC VMAX</p>

Claims	Exemplary Evidence of Infringement
<p>1 [a] logic circuitry configured to:</p>	<p>The Accused Products comprise logic circuitry and software that configures the logic circuitry.</p> <p>For example, the Accused Products include “Intel Xeon” “CPU[s],” “PowerMaxOS”/“HYPERMAX OS”/“ENGINUITY OS,” and/or “Unisphere” which “enables you to configure and manage” the Accused Products, and “Fully Automated Storage Tiering (FAST)” for the “automat[ion and] management of storage system disk resources”</p> <p><i>See, e.g.:</i></p>  <p>Servers, Storage & Networking – Storage – PowerMax</p>

Claims	Exemplary Evidence of Infringement		
	Array family	PowerMax 2500	PowerMax 8500
	Node Pairs		
	NUMBER OF NODE PAIRS	1 to 2	1 to 8
	NODE PAIR MODULE	3U	3U
	CPU	Memory config 1-3: Intel Xeon Gold 5218 2.8 GHz with 16 core ¹	Memory config 2-3: Intel Xeon Gold 6254 3.9 GHz with 18 core ¹
		Memory config 4: Intel Xeon Gold 6240L	Memory Config 4: Intel Xeon Gold 8280L
	CORE NUMBER PER CPU/PER NODE PAIR/PER SYSTEM	Memcfg 1-3: 16/64/128 Memcfg 4: 18/72/144 ⁵	Memcfg 1-3: 18/72/576 Memcfg 4: 20/80/608 ^{4,5}
	<u>Specification Sheet – Dell PowerMax Array – DELL POWERMAX – Dell PowerMax 2500 and 8500</u>		
	Array family	PowerMax 2000	PowerMax 8000
	Bricks/zBricks		
	Number of Bricks or zBricks ⁵	1 to 2	1 to 8
	ENGINE ENCLOSURE	4u	4u
	CPU	Intel Xeon E5-2650-v4	Intel Xeon E5-2697-v4
		2.5 GHz 12 core ⁴	2.8 GHz 18 core ⁴
	# CORES PER CPU/PER ENGINE/PER SYSTEM	12/48/96	18/72/576
	<u>Specification Sheet – POWERMAX FAMILY – PowerMax 2000 and 8000</u>		

Claims**Exemplary Evidence of Infringement**Data Storage – VMAX All Flash


Array family	VMAX 250F/VMAX 250FX	VMAX 950F/VMAX 950FX
V-BRICKS		
Number of V-Bricks	1 to 2	1 to 8
ENGINE ENCLOSURE	4u	4u
CPU	Intel Xeon E5-2650-v4 42.5 GHz 12 core	Intel Xeon E5-2697-v4 42.8 GHz 18 core
# CORES PER CPU/PER ENGINE/PER SYSTEM	12/48/96	18/72/576

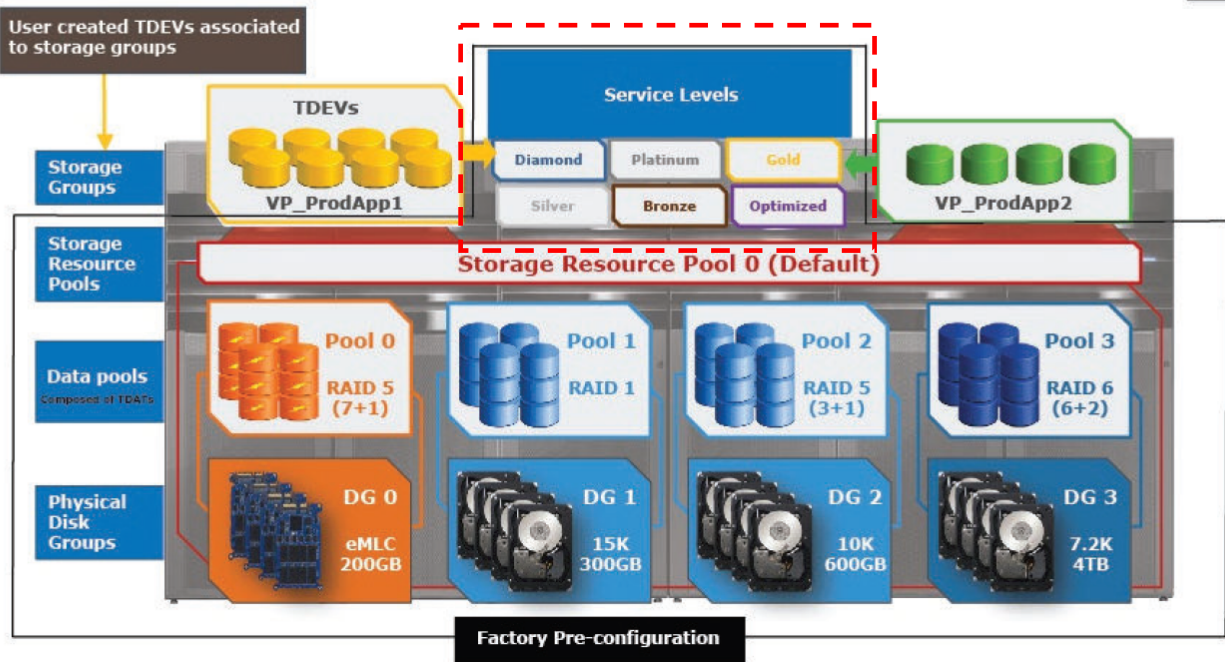
Specification Sheet – VMAX ALL FLASH FAMILY – VMAX 250F, 950F

ARRAY FAMILY	VMAX 450F/VMAX 450FX	VMAX 850F/VMAX 850FX
V-BRICKS		
NUMBER OF V-BRICKS	1 to 4	1 to 8
ENGINE ENCLOSURE	4u	4u
CPU	Intel Xeon E5-2650-v2 43.0 GHz 8 core	Intel Xeon E5-2697-v2 43.0 GHz 12 core
# CORES PER CPU/PER ENGINE/PER SYSTEM	8/32/128	12/48/384

Specification Sheet – VMAX ALL FLASH FAMILY – VMAX 450F, 850F

Claims	Exemplary Evidence of Infringement			
	VMAX3 FAMILY SPECIFICATIONS			
	VMAX3 ARRAY ENGINE	VMAX 100K	VMAX 200K	VMAX 400K
	Number of Engines supported	1 to 2	1 to 4	1 to 8
	Engine Enclosure	4u	4u	4u
	CPU	Intel Xeon E5-2620-v2 2.1 GHz 6 core	Intel Xeon E5-2650-v2 2.6 GHz 8 core	Intel Xeon E5-2697-v2 2.7 GHz 12 core
	Dynamic Virtual Matrix BW	700GB/s	700GB/s	1400GB/s
	# Cores per CPU/per Engine/per System	6/24/48	8/32/128	12/48/384
<u>Specification Sheet – DELL EMC VMAX3 FAMILY – VMAX 100K, 200K, 400K</u>				
<u>Unisphere enables you to configure and manage PowerMax, VMAX All Flash, and VMAX storage systems.</u>				
Unisphere is a HTML5 web-based application that enables you to configure and manage <u>PowerMax, VMAX All Flash, and VMAX storage systems.</u> The term Unisphere incorporates "Unisphere for PowerMax" for the management of PowerMax and All Flash storage systems running <u>PowerMaxOS 5978</u> , and "Unisphere for VMAX" for the management of VMAX All Flash and VMAX storage systems running <u>HYPERMAX OS 5977</u> and <u>Enginuity OS 5876</u> .				
Blog posts and videos that provide an overview of Unisphere functionality can be accessed by clicking here .				

Claims	Exemplary Evidence of Infringement
	<p><u>Fully Automated Storage Tiering (FAST) automates management of storage system disk resources on behalf of thin volumes.</u></p> <p> Note: This section describes FAST operations for storage systems running HYPERMAX OS 5977 or higher.</p> <p>FAST automatically configures disk groups to form a Storage Resource Pool by creating thin pools according to each individual disk technology, capacity, and RAID type.</p> <p><u>FAST technology moves the most active parts of your workloads (hot data) to high-performance flash disks and the least-frequently accessed storage (cold data) to lower-cost drives, using the best performance and cost characteristics of each different drive type.</u> FAST delivers higher performance using fewer drives to help reduce acquisition, power, cooling, and footprint costs. FAST can factor in the RAID protections to ensure write heavy workloads go to RAID 1 and read heavy workloads go to RAID 6. This process is entirely automated and requires no user intervention.</p> <p><u>FAST also delivers variable performance levels through service levels.</u> Thin volumes can be added to storage groups and the storage group can be associated with a specific service level to set performance expectations.</p> <p><u>FAST monitors the performance of the storage group relative to the service level and automatically provisions the appropriate disk resources to maintain a consistent performance level.</u></p> <p>Dell EMC Unisphere for PowerMax Product Guide</p>
1 [b] identify service level agreements associated with different storage volumes;	<p>The Accused Products identify service level agreements associated with different storage volumes.</p> <p>For example, the Accused Products “are preconfigured with . . . service levels and workloads” that are used to “specify the performance objectives” and “ensure that applications have consistent and predictable performance,” where a “service level is the response time target for the storage group.” For example, the “[t]arget response time” is the “average response time expected for the storage group based on the selected service level,” and along with a “target response time, service levels also have either an upper response time limit or both an upper and lower response time limit.”</p> <p><i>See, e.g.:</i></p>

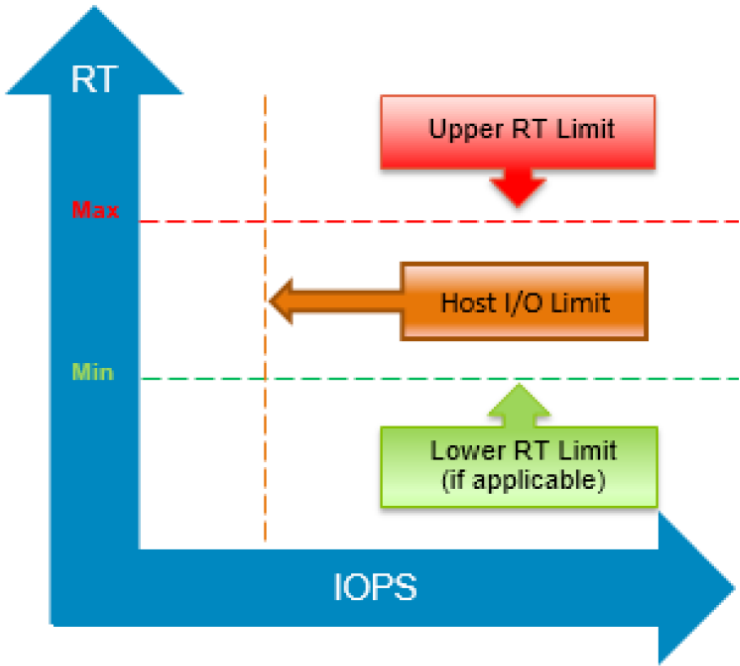
Claims	Exemplary Evidence of Infringement
	<p>By default, storage systems running HYPERMAX OS 5977 or higher are preconfigured with a single Storage Resource Pool (SRP). The SRP contains all the hard disks on the system that is organized into disk groups by technology, capacity, rotational speed, and RAID protection type. Storage administrators can view all SRPs configured on the system, and the demand that storage groups are placing on them.</p> <p><u>Storage systems are also preconfigured with several service levels and workloads. Storage administrators use the service levels and workloads to specify the performance objectives for the application they are provisioning.</u></p> <p>When provisioning storage for an application, storage administrators assign the appropriate SRP, service level, and workload to the storage group containing the LUNs associated with the application.</p>  <p>The diagram illustrates the storage system architecture. At the top, 'User created TDEVs associated to storage groups' points to 'Storage Groups'. Two storage groups are shown: 'VP_ProdApp1' and 'VP_ProdApp2'. 'VP_ProdApp1' is associated with 'TDEVs' (yellow cylinders) and 'Service Levels' (Diamond, Platinum, Gold, Silver, Bronze, Optimized). 'VP_ProdApp2' is associated with 'Service Levels' (Gold, Optimized). Below the storage groups is 'Storage Resource Pool 0 (Default)'. This pool is composed of four 'Data pools' (RAID 5 (7+1), RAID 1, RAID 5 (3+1), RAID 6 (6+2)). These data pools are mapped to four 'Physical Disk Groups' (DG 0, DG 1, DG 2, DG 3). DG 0 is eMLC 200GB, DG 1 is 15K 300GB, DG 2 is 10K 600GB, and DG 3 is 7.2K 4TB. The entire system is labeled 'Factory Pre-configuration'.</p>

Claims	Exemplary Evidence of Infringement
	<p><u>A service level is the response time target for the storage group. The service level enables you set the storage array with the desired response time target for the storage group.</u></p> <p>It automatically monitors and adapts to the workload to maintain (or meet) the response time target. The service level includes an optional workload type. The optional workload type can be used to further tune expectations for the workload storage group to provide enough flash to meet your performance objective.</p> <p>Dell EMC Unisphere for PowerMax Product Guide</p> <p>PowerMaxOS: Beginning with 5978, the operating environment run on PowerMax and VMAX All Flash systems.</p> <p>Storage group (SG): A logical grouping of thin devices that are provisioned and associated with a particular application.</p> <p>Response time (RT): The total amount of time it takes to respond to a request for service.</p> <p><u>Target response time: The average response time expected for the storage group based on the selected service level.</u></p> <p><u>Upper response time limit: The maximum response time specified by the selected service level.</u></p> <p><u>Lower response time limit: The minimum response time specified by the selected service level.</u></p> <p><u>Service levels for PowerMaxOS ensure that applications have consistent and predictable performance by allowing users to separate storage groups based on performance requirements and business importance. PowerMaxOS allows you to set specific service levels to ensure the highest-priority application response times are not impacted by lower-priority applications. The available service levels are defined in PowerMaxOS and can be applied at the creation of a storage group or can be modified to an existing storage group at any time.</u></p>

Claims	Exemplary Evidence of Infringement																												
	<h3>Service level options</h3> <p><u>Service levels are offered with various ranges of performance expectations which are defined by their own characteristics of a target response time. The target response time is the average response time expected for the storage group based on the selected service level. Along with a target response time, service levels also have either an upper response time limit or both an upper and lower response time limit.</u></p> <p>The service levels offered are detailed in Table 1. All service levels shown, with the exception of Optimized, have a target response time.</p> <p>Table 1 Service levels for PowerMaxOS</p> <table><tr><th>Service level</th><th>Diamond</th><th>Platinum</th><th>Gold</th><th>Silver</th><th>Bronze</th><th>Optimized</th></tr><tr><td>Target response time</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr><tr><td>Upper response time limit</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr><tr><td>Lower response time limit</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td></td></tr></table> <div><div>← Highest</div><div>Priority and performance</div><div>Lowest →</div></div> <p>Diamond, Platinum, and Gold: These service levels have the highest priority and performance. Each has an upper response time limit but no lower response time limit which ensures they will be serviced as fast as possible.</p>	Service level	Diamond	Platinum	Gold	Silver	Bronze	Optimized	Target response time	✓	✓	✓	✓	✓		Upper response time limit	✓	✓	✓	✓	✓		Lower response time limit				✓	✓	
Service level	Diamond	Platinum	Gold	Silver	Bronze	Optimized																							
Target response time	✓	✓	✓	✓	✓																								
Upper response time limit	✓	✓	✓	✓	✓																								
Lower response time limit				✓	✓																								


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	<p>Silver and Bronze: These service levels have both an upper and lower limit designed to allow higher-priority service levels to be unaffected. These are managed such that their average response time will be greater than or equal to the lower response time limit.</p> <p>Optimized: This service level does not have a target response time nor an upper or lower limit. Optimized is designed to use all allowable resources, equal to that of Diamond, and is not managed to assist any other service level. Storage groups set with any other service level will also not be managed to assist storage groups set Optimized. Optimized should be used on systems where application performance and consistency are not of relative importance and should not be mixed on systems with other service levels.</p> <p>The following table shows the target response time for each service level along with an indication of the lower response time.</p> <p>Table 2 Service level response times</p> <table><tr><th>Service level</th><th>Target response time</th><th>Lower response time</th></tr><tr><td>Diamond</td><td>0.6 ms*</td><td>None</td></tr><tr><td>Platinum</td><td>0.8 ms*</td><td>None</td></tr><tr><td>Gold</td><td>1 ms</td><td>None</td></tr><tr><td>Silver</td><td>3.6 ms</td><td>~3.6 ms</td></tr><tr><td>Bronze</td><td>7.2 ms</td><td>~7.2 ms</td></tr><tr><td>Optimized</td><td>N/A</td><td>N/A</td></tr></table> <p>Setting service levels</p> <p><u>Service levels can be applied to a storage group when either creating a new storage group or by modifying an existing storage group. Users also have the ability to change service levels at any time to apply the desired response time performance expectation.</u></p>	Service level	Target response time	Lower response time	Diamond	0.6 ms*	None	Platinum	0.8 ms*	None	Gold	1 ms	None	Silver	3.6 ms	~3.6 ms	Bronze	7.2 ms	~7.2 ms	Optimized	N/A	N/A
Service level	Target response time	Lower response time																				
Diamond	0.6 ms*	None																				
Platinum	0.8 ms*	None																				
Gold	1 ms	None																				
Silver	3.6 ms	~3.6 ms																				
Bronze	7.2 ms	~7.2 ms																				
Optimized	N/A	N/A																				

Claims	Exemplary Evidence of Infringement
	<p data-bbox="430 235 982 284">Service level functionality</p> <p data-bbox="430 297 1755 472"><u>Service levels for PowerMaxOS are designed to put relative importance on application storage groups. This function allows users to manage applications based on predictability and consistency in response time.</u> With the ability to manage the performance of the array, users can determine whether to utilize as much of the resources the array allows or as little of the resources regardless of the system capabilities. With this ability to manage performance, users assign importance on applications based on specific needs.</p> <div data-bbox="430 574 1449 1295"> <p>The diagram illustrates the relationship between service levels and performance metrics. A large blue arrow points from the bottom-left towards the top-right. The vertical axis of the arrow is labeled 'RT' (Relative Time) and the horizontal axis is labeled 'IOPS' (Input/Output Operations Per Second). Five colored circles, representing different service levels, are positioned along the path of the arrow. From top-left to bottom-right, they are: Bronze (red), Silver (grey), Gold (yellow), Platinum (light blue), and Diamond (white). The word 'Optimized' is written near the Silver circle. The arrangement suggests that as IOPS increase and RT decreases, the service level improves from Bronze to Diamond.</p> </div> <p data-bbox="430 1312 1087 1341">Figure 10 Relative response time compared to IOPS</p>

Claims	Exemplary Evidence of Infringement
	<p>Figure 13 illustrates <u>service levels as they apply to the response-time upper and lower limits</u> and shows how host I/O limits relate to setting the maximum allowable throughput IOPS.</p>  <p>Figure 13 Service level management relative to host I/O limits</p> <p>Technical White Paper – Dell EMC PowerMax: Service Levels for PowerMaxOS</p>
1 [c] monitor storage access performance for the different	<p>The Accused Products monitor storage access performance for the different storage volumes.</p> <p>For example, the Accused Products “monitor[] the performance of the storage group relative to the service level” and provide an “overall view of the status of the storage systems,” including “[s]ervice level compliance data,” “[c]urrent throughput for the system,” and “[c]urrent IOPS for the system.” For example, the Accused Products “provide a view of key performance indicators” including “[h]ost IOs/sec in terms of read and write operations over time,” “[l]atency in terms of read and write operations over time,” and “[t]hroughput in terms of read and write operations over time.”</p>

Claims	Exemplary Evidence of Infringement
storage volumes;	<p><i>See, e.g.:</i></p> <p><u>FAST monitors the performance of the storage group relative to the service level and automatically provisions the appropriate disk resources to maintain a consistent performance level.</u></p> <p><u>Service Levels management - A service level is the response time target for a storage group. The service level sets the storage array with the required response time target for a storage group. It automatically monitors and adapts to the workload needed maintain the response time target. The service level includes an optional workload type so it can be optimized to meet performance levels.</u></p> <p><u>Storage Resource Pools management - Fully Automated Storage Tiering (FAST) provides automated management of storage array disk resources to achieve expected service levels. FAST automatically configures disk groups to form a Storage Resource Pool (SRP) by creating thin pools according to each individual disk technology, capacity, and RAID type.</u></p> <p><u>Dell EMC Unisphere for PowerMax Product Guide</u></p> <p><u>The home dashboard view for all storage systems (the default view after logging in) provides an overall view of the status of the storage systems that Unisphere manages in terms of the following:</u></p> <ul style="list-style-type: none"> • <u>Compliance—Service level compliance data</u> in the form of storage group counts for each compliance state (Critical, Marginal, Stable), total storage group count, and number of storage groups with no service level assigned. • Capacity—Percentage of allocated capacity for the storage system • Health score—an overall health score based on the lowest health score out of the five metrics (see Understanding the system health score on page 8 for more information). • <u>Throughput—Current throughput for the system, in MB/second</u> • <u>IOPS—Current IOPS for the system</u>

Claims	Exemplary Evidence of Infringement
	<p>The performance and capacity dashboard for a specific storage system provides a view of key performance and capacity indicators.</p> <ul style="list-style-type: none"> • A Performance panel displays the following graphs over a four hour, one week, or two-week period: <ul style="list-style-type: none"> ▪ <u>Host IOs/sec in terms of read and write operations over time.</u> ▪ <u>Latency in terms of read and write operations over time.</u> ▪ <u>Throughput in terms of read and write operations over time.</u> <p>To the right of each graph, a list of the top five active storage groups for that graph is displayed. Zooming in to a timeframe on a graph automatically updates the top five storage groups lists for that timeframe. Clicking a particular point in time on one graph automatically updates the top five storage group lists for that particular time.</p> <p>Technical White Paper – Dell EMC PowerMax: Service Levels for PowerMaxOS</p>
1 [d] compare the storage access performance with the service level agreements associated with the different storage volumes; and	<p>The Accused Products compare the storage access performance with the service level agreements associated with the different storage volumes.</p> <p>For example, the Accused Products “monitor[] the performance of the storage group relative to the service level,” “continually monitor[] the system to ensure that any lower-priority applications are minimally-disruptive to higher-priority applications,” and the “home dashboard view for all storage systems that Unisphere manages in terms of the following: Compliance—Service level compliance data”</p> <p><i>See, e.g.:</i></p>

Claims	Exemplary Evidence of Infringement
	<p><u>Fully Automated Storage Tiering (FAST) automates management of storage system disk resources on behalf of thin volumes.</u></p> <p> Note: This section describes FAST operations for storage systems running HYPERMAX OS 5977 or higher.</p> <p>FAST automatically configures disk groups to form a Storage Resource Pool by creating thin pools according to each individual disk technology, capacity, and RAID type.</p> <p><u>FAST technology moves the most active parts of your workloads (hot data) to high-performance flash disks and the least-frequently accessed storage (cold data) to lower-cost drives,</u> using the best performance and cost characteristics of each different drive type. FAST delivers higher performance using fewer drives to help reduce acquisition, power, cooling, and footprint costs. FAST can factor in the RAID protections to ensure write heavy workloads go to RAID 1 and read heavy workloads go to RAID 6. This process is entirely automated and requires no user intervention.</p> <p><u>FAST also delivers variable performance levels through service levels.</u> Thin volumes can be added to storage groups and the storage group can be associated with a specific service level to set performance expectations.</p> <p><u>FAST monitors the performance of the storage group relative to the service level and automatically provisions the appropriate disk resources to maintain a consistent performance level.</u></p> <p><u>Service Levels management - A service level is the response time target for a storage group.</u> The service level sets the storage array with the required response time target for a storage group. <u>It automatically monitors and adapts to the workload needed maintain the response time target.</u> The service level includes an optional workload type so it can be optimized to meet performance levels.</p> <p>Templates management - Using the configuration and performance characteristics of an existing storage group as a starting point, you can create templates that will prepopulate fields in the provisioning wizard and create a more realistic performance reservation in your future provisioning requests.</p> <p>Storage Resource Pools management - <u>Fully Automated Storage Tiering (FAST) provides automated management of storage array disk resources to achieve expected service levels.</u> FAST automatically configures disk groups to form a Storage Resource Pool (SRP) by creating thin pools according to each individual disk technology, capacity, and RAID type.</p>

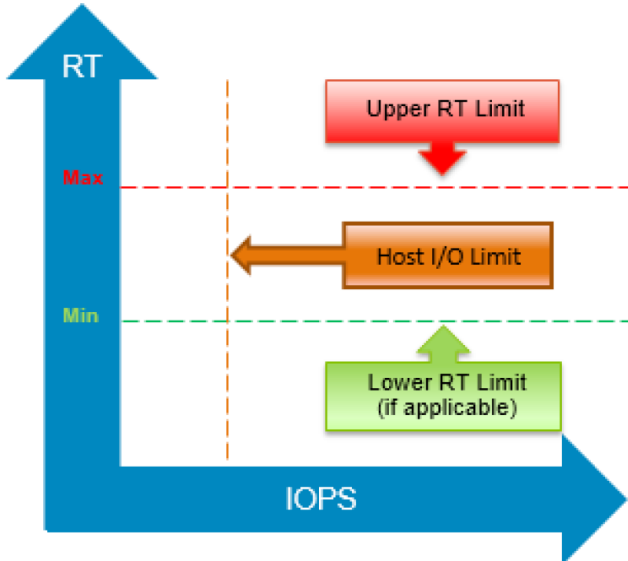
Claims	Exemplary Evidence of Infringement
	<p data-bbox="415 235 1073 264">Dell EMC Unisphere for PowerMax Product Guide</p> <p data-bbox="426 302 1829 418"><u>The home dashboard view for all storage systems (the default view after logging in) provides an overall view of the status of the storage systems that Unisphere manages in terms of the following:</u></p> <ul data-bbox="426 443 1871 820" style="list-style-type: none"> <li data-bbox="426 443 1871 560">• <u>Compliance—Service level compliance data</u> in the form of storage group counts for each compliance state (Critical, Marginal, Stable), total storage group count, and number of storage groups with no service level assigned. <li data-bbox="426 581 1472 613">• Capacity—Percentage of allocated capacity for the storage system <li data-bbox="426 634 1860 711">• Health score—an overall health score based on the lowest health score out of the five metrics (see Understanding the system health score on page 8 for more information). <li data-bbox="426 732 1430 764">• <u>Throughput—Current throughput for the system, in MB/second</u> <li data-bbox="426 786 1020 820">• <u>IOPS—Current IOPS for the system</u> <p data-bbox="426 873 1801 950">The performance and capacity dashboard for a specific storage system provides a view of key performance and capacity indicators.</p> <ul data-bbox="426 976 1839 1222" style="list-style-type: none"> <li data-bbox="426 976 1839 1052">• A Performance panel displays the following graphs over a four hour, one week, or two-week period: <ul data-bbox="478 1076 1440 1222" style="list-style-type: none"> <li data-bbox="478 1076 1440 1109">▪ <u>Host IOs/sec</u> in terms of read and write operations over time. <li data-bbox="478 1130 1360 1162">▪ <u>Latency</u> in terms of read and write operations over time. <li data-bbox="478 1183 1419 1222">▪ <u>Throughput</u> in terms of read and write operations over time. <p data-bbox="478 1247 1829 1403">To the right of each graph, a list of the top five active storage groups for that graph is displayed. Zooming in to a timeframe on a graph automatically updates the top five storage groups lists for that timeframe. Clicking a particular point in time on one graph automatically updates the top five storage group lists for that particular time.</p>


Claims	Exemplary Evidence of Infringement
	<p>PowerMaxOS: Beginning with 5978, the operating environment run on PowerMax and VMAX All Flash systems.</p> <p>Storage group (SG): A logical grouping of thin devices that are provisioned and associated with a particular application.</p> <p>Response time (RT): The total amount of time it takes to respond to a request for service.</p> <p><u>Target response time:</u> The average response time expected for the storage group based on the selected service level.</p> <p><u>Upper response time limit:</u> The maximum response time specified by the selected service level.</p> <p><u>Lower response time limit:</u> The minimum response time specified by the selected service level.</p> <p>Service level options</p> <p><u>Service levels are offered with various ranges of performance expectations which are defined by their own characteristics of a target response time. The target response time is the average response time expected for the storage group based on the selected service level. Along with a target response time, service levels also have either an upper response time limit or both an upper and lower response time limit.</u></p> <p><u>Service levels for PowerMaxOS ensure that applications have consistent and predictable performance by allowing users to separate storage groups based on performance requirements and business importance. PowerMaxOS allows you to set specific service levels to ensure the highest-priority application response times are not impacted by lower-priority applications. The available service levels are defined in PowerMaxOS and can be applied at the creation of a storage group or can be modified to an existing storage group at any time.</u></p>

Claims	Exemplary Evidence of Infringement
	<p data-bbox="432 235 882 272">How service levels work</p> <p data-bbox="432 289 1701 451">PowerMaxOS is continually monitoring the system to ensure that any lower-priority applications are minimally <u>disruptive to higher-priority applications</u>. When the higher-priority applications' response times begin to approach the upper limit of the selected service level, the system begins to manage any lower-priority storage groups. The process of monitoring and the management of lower-priority applications both happen in real time.</p> <p data-bbox="432 488 1671 581">PowerMaxOS uses real-time machine learning to model workload characteristics. This model provides a predictive function that allows PowerMaxOS to anticipate workload demand for a storage group. With these anticipated workload demands, it can adapt as necessary to changes in block size, write ratio, or I/O load.</p> <p data-bbox="432 618 1696 748"><u>A storage group with a higher-priority service level that is affected by any lower-priority storage groups will trigger response-time management to the lower-priority service levels.</u> When the higher-priority storage group reaches its target response time, all lower storage groups will continue to be managed until the lowest-priority storage groups reach their target response time.</p> <p data-bbox="432 786 1667 915"><u>The management of any lower-priority service level is imposed by a response-time delay in I/O. The delay gradually increases over time to keep the higher-priority storage group within its respective target response time.</u> The delay gradually decreases to ensure that the higher-priority storage group remains within its response time.</p>

Claims	Exemplary Evidence of Infringement
	<p data-bbox="430 235 997 284">Service level functionality</p> <p data-bbox="430 297 1787 475"><u>Service levels for PowerMaxOS are designed to put relative importance on application storage groups. This function allows users to manage applications based on predictability and consistency in response time.</u> With the ability to manage the performance of the array, users can determine whether to utilize as much of the resources the array allows or as little of the resources regardless of the system capabilities. With this ability to manage performance, users assign importance on applications based on specific needs.</p> <div data-bbox="430 576 1480 1307"> </div> <p data-bbox="430 1320 1102 1352">Figure 10 Relative response time compared to IOPS</p>

Claims	Exemplary Evidence of Infringement
	<p data-bbox="432 237 779 277">Priority applications</p> <p data-bbox="432 285 1640 448"><u>Service levels allow users to insulate specific storage groups from the performance impact of other noisy-neighbor applications. The user can assign critical applications to higher service levels such as Diamond, Platinum, or Gold which allow for these storage groups to utilize all available resources at all times.</u> These critical applications are not managed unless the system exhibits resource constraints causing the applications to fail to maintain desired performance levels.</p> <p data-bbox="432 480 1612 602">In Figure 11, the lower-priority storage groups begin to impede on the response-time boundary of a storage group with a higher service level. The lower-priority storage group is then managed by PowerMaxOS. The management of lower-priority storage groups subsides once the higher-priority storage group is within its respective target service level.</p> <p data-bbox="432 618 1003 659">Service levels and host I/O limits</p> <p data-bbox="432 667 1619 829"><u>Service levels ensure storage groups have an expectation of performance in terms of response time while host I/O limits provide a function to limit the amount of front-end port performance.</u> Host I/O limits do this by allowing users to set a maximum front-end throughput on either IOPS, MB/s, or a combination of both. When a host I/O limit is applied to a storage group that has a service level set, the storage group will still be managed by any higher-priority storage group.</p> <p data-bbox="432 862 1629 1057"><u>Both service levels and host I/O limits are set per storage group and can work together for more predictable and consistent performance.</u> Host I/O limits can be set on a storage group that has a specified service level to manage the front-end throughput if the desired response-time performance of the storage group is continually being exceeded or if the storage group is being impeded upon by other storage groups. Host I/O limits are not a method to maintain response time but allow users to control how much data is being driven to the array, which help service levels maintain consistent response-time performance.</p>

Claims	Exemplary Evidence of Infringement
	<p data-bbox="426 238 1650 298"><u>Figure 13 illustrates service levels as they apply to the response-time upper and lower limits and shows how host I/O limits relate to setting the maximum allowable throughput IOPS.</u></p>  <p data-bbox="426 911 1146 938">Figure 13 Service level management relative to host I/O limits</p> <p data-bbox="415 954 1455 987"><u>Technical White Paper – Dell EMC PowerMax: Service Levels for PowerMaxOS</u></p>
<p data-bbox="205 1029 380 1414">1 [e] allocate tiering media to the different storage volumes and allocate more tiering media to the different storage</p>	<p data-bbox="415 1029 1902 1130">The Accused Products allocate tiering media to the different storage volumes and allocate more tiering media to the different storage volumes in response to the storage access performance not meeting the service level agreements for the different storage volumes.</p> <p data-bbox="415 1166 1915 1414">For example, the Accused Products “automate[] management of storage system disk resources,” offering “[s]ervice levels . . . with various ranges of performance expectations, which are defined by their own characteristics of a target response time,” where the “target response time is the average response time expected for the storage group based on the selected service level” and the “automated management of storage array disk resources . . . achieve[s] expected service levels.” For example, the Accused Products “automatically monitor[] and adapt[] to the workload to maintain (or meet) the response time target.” For example, the Accused Products “ensure storage groups have an expectation of performance in terms of response time” which “allows users to manage applications based on predictability and</p>

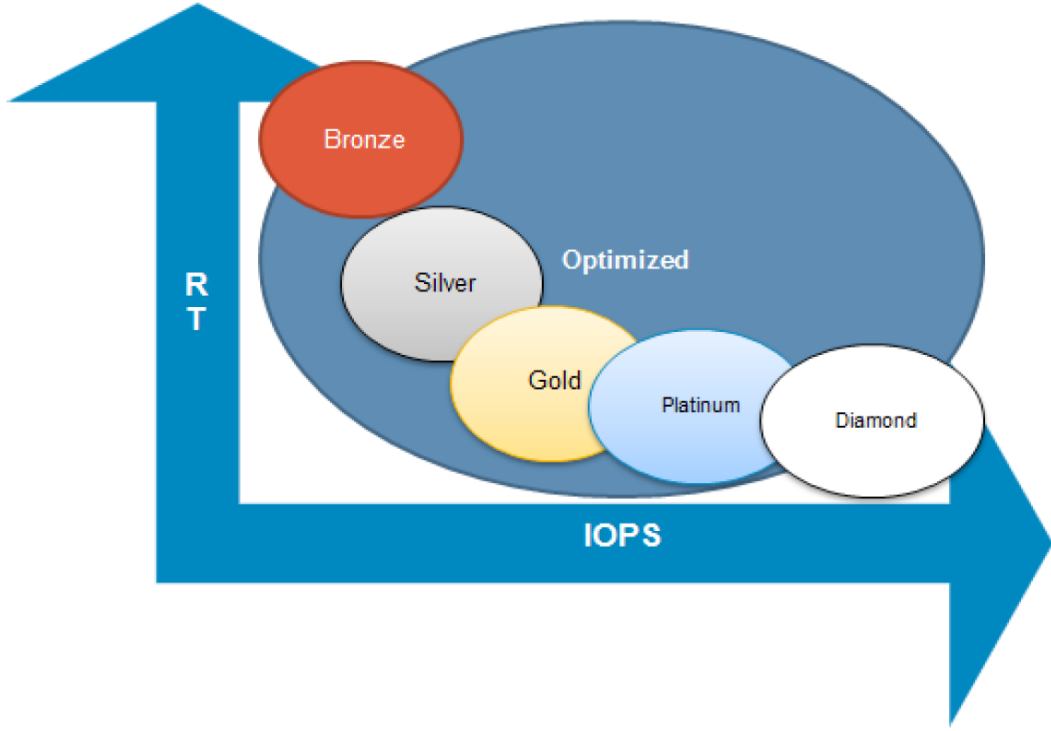
Claims	Exemplary Evidence of Infringement
<p>volumes in response to the storage access performance not meeting the service level agreements for the different storage volumes.</p>	<p>consistency in response time.” For example, the Accused Products can “move[] the most active parts of your workload (hot data) to high-performance flash disks and the least-frequently accessed storage (cold data) to lower-cost drives”</p> <p><i>See, e.g.:</i></p> <p><u>Fully Automated Storage Tiering (FAST) automates management of storage system disk resources on behalf of thin volumes.</u></p> <p> Note: This section describes FAST operations for storage systems running HYPERMAX OS 5977 or higher.</p> <p>FAST automatically configures disk groups to form a Storage Resource Pool by creating thin pools according to each individual disk technology, capacity, and RAID type.</p> <p><u>FAST technology moves the most active parts of your workloads (hot data) to high-performance flash disks and the least-frequently accessed storage (cold data) to lower-cost drives, using the best performance and cost characteristics of each different drive type. FAST delivers higher performance using fewer drives to help reduce acquisition, power, cooling, and footprint costs. FAST can factor in the RAID protections to ensure write heavy workloads go to RAID 1 and read heavy workloads go to RAID 6. This process is entirely automated and requires no user intervention.</u></p> <p><u>FAST also delivers variable performance levels through service levels. Thin volumes can be added to storage groups and the storage group can be associated with a specific service level to set performance expectations.</u></p> <p><u>FAST monitors the performance of the storage group relative to the service level and automatically provisions the appropriate disk resources to maintain a consistent performance level.</u></p>

Claims	Exemplary Evidence of Infringement
	<p><u>A service level is the response time target for the storage group.</u> The service level enables you set the storage array with the desired response time target for the storage group.</p> <p>It automatically monitors and adapts to the workload to maintain (or meet) the response time target. The service level includes an optional workload type. The optional workload type can be used to further tune expectations for the workload storage group to provide enough flash to meet your performance objective.</p> <p><u>Service Levels management - A service level is the response time target for a storage group. The service level sets the storage array with the required response time target for a storage group. It automatically monitors and adapts to the workload needed maintain the response time target.</u> The service level includes an optional workload type so it can be optimized to meet performance levels.</p> <p>Templates management - Using the configuration and performance characteristics of an existing storage group as a starting point, you can create templates that will prepopulate fields in the provisioning wizard and create a more realistic performance reservation in your future provisioning requests.</p> <p>Storage Resource Pools management - <u>Fully Automated Storage Tiering (FAST) provides automated management of storage array disk resources to achieve expected service levels.</u> FAST automatically configures disk groups to form a Storage Resource Pool (SRP) by creating thin pools according to each individual disk technology, capacity, and RAID type.</p> <p>Dell EMC Unisphere for PowerMax Product Guide</p>

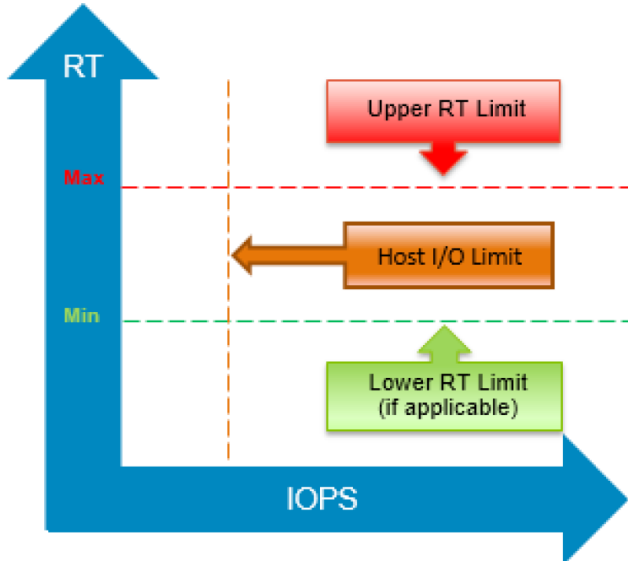
Claims	Exemplary Evidence of Infringement
	<p><u>The home dashboard view for all storage systems (the default view after logging in) provides an overall view of the status of the storage systems that Unisphere manages in terms of the following:</u></p> <ul style="list-style-type: none"> • <u>Compliance—Service level compliance data</u> in the form of storage group counts for each compliance state (Critical, Marginal, Stable), total storage group count, and number of storage groups with no service level assigned. • Capacity—Percentage of allocated capacity for the storage system • Health score—an overall health score based on the lowest health score out of the five metrics (see Understanding the system health score on page 8 for more information). • <u>Throughput—Current throughput for the system, in MB/second</u> • <u>IOPS—Current IOPS for the system</u> <p>The performance and capacity dashboard for a specific storage system provides a view of key performance and capacity indicators.</p> <ul style="list-style-type: none"> • A Performance panel displays the following graphs over a four hour, one week, or two-week period: <ul style="list-style-type: none"> ▪ <u>Host IOs/sec in terms of read and write operations over time.</u> ▪ <u>Latency in terms of read and write operations over time.</u> ▪ <u>Throughput in terms of read and write operations over time.</u> <p>To the right of each graph, a list of the top five active storage groups for that graph is displayed. Zooming in to a timeframe on a graph automatically updates the top five storage groups lists for that timeframe. Clicking a particular point in time on one graph automatically updates the top five storage group lists for that particular time.</p>

Claims	Exemplary Evidence of Infringement
	<p>PowerMaxOS: Beginning with 5978, the operating environment run on PowerMax and VMAX All Flash systems.</p> <p>Storage group (SG): A logical grouping of thin devices that are provisioned and associated with a particular application.</p> <p>Response time (RT): The total amount of time it takes to respond to a request for service.</p> <p><u>Target response time: The average response time expected for the storage group based on the selected service level.</u></p> <p><u>Upper response time limit: The maximum response time specified by the selected service level.</u></p> <p><u>Lower response time limit: The minimum response time specified by the selected service level.</u></p> <p>Service level options</p> <p><u>Service levels are offered with various ranges of performance expectations which are defined by their own characteristics of a target response time. The target response time is the average response time expected for the storage group based on the selected service level. Along with a target response time, service levels also have either an upper response time limit or both an upper and lower response time limit.</u></p>

Claims	Exemplary Evidence of Infringement
	<p data-bbox="436 237 936 277">How service levels work</p> <p data-bbox="436 293 1850 480"><u>PowerMaxOS is continually monitoring the system to ensure that any lower-priority applications are minimally disruptive to higher-priority applications.</u> When the higher-priority applications' response times begin to approach the upper limit of the selected service level, the system begins to manage any lower-priority storage groups. The process of monitoring and the management of lower-priority applications both happen in real time.</p> <p data-bbox="436 516 1818 621">PowerMaxOS uses real-time machine learning to model workload characteristics. This model provides a predictive function that allows PowerMaxOS to anticipate workload demand for a storage group. With these anticipated workload demands, it can adapt as necessary to changes in block size, write ratio, or I/O load.</p> <p data-bbox="436 662 1850 808"><u>A storage group with a higher-priority service level that is affected by any lower-priority storage groups will trigger response-time management to the lower-priority service levels.</u> When the higher-priority storage group reaches its target response time, all lower storage groups will continue to be managed until the lowest-priority storage groups reach their target response time.</p> <p data-bbox="436 846 1818 992"><u>The management of any lower-priority service level is imposed by a response-time delay in I/O. The delay gradually increases over time to keep the higher-priority storage group within its respective target response time.</u> The delay gradually decreases to ensure that the higher-priority storage group remains within its response time.</p>

Claims	Exemplary Evidence of Infringement
	<p>Service level functionality</p> <p><u>Service levels for PowerMaxOS are designed to put relative importance on application storage groups. This function allows users to manage applications based on predictability and consistency in response time.</u> With the ability to manage the performance of the array, users can determine whether to utilize as much of the resources the array allows or as little of the resources regardless of the system capabilities. With this ability to manage performance, users assign importance on applications based on specific needs.</p>  <p>Figure 10 Relative response time compared to IOPS</p>

Claims	Exemplary Evidence of Infringement
	<p data-bbox="432 237 779 277">Priority applications</p> <p data-bbox="432 285 1640 448"><u>Service levels allow users to insulate specific storage groups from the performance impact of other noisy-neighbor applications. The user can assign critical applications to higher service levels such as Diamond, Platinum, or Gold which allow for these storage groups to utilize all available resources at all times.</u> These critical applications are not managed unless the system exhibits resource constraints causing the applications to fail to maintain desired performance levels.</p> <p data-bbox="432 480 1612 602">In Figure 11, the lower-priority storage groups begin to impede on the response-time boundary of a storage group with a higher service level. The lower-priority storage group is then managed by PowerMaxOS. The management of lower-priority storage groups subsides once the higher-priority storage group is within its respective target service level.</p> <p data-bbox="432 643 1003 683">Service levels and host I/O limits</p> <p data-bbox="432 691 1619 854"><u>Service levels ensure storage groups have an expectation of performance in terms of response time while host I/O limits provide a function to limit the amount of front-end port performance.</u> Host I/O limits do this by allowing users to set a maximum front-end throughput on either IOPS, MB/s, or a combination of both. When a host I/O limit is applied to a storage group that has a service level set, the storage group will still be managed by any higher-priority storage group.</p> <p data-bbox="432 886 1629 1089"><u>Both service levels and host I/O limits are set per storage group and can work together for more predictable and consistent performance.</u> Host I/O limits can be set on a storage group that has a specified service level to manage the front-end throughput if the desired response-time performance of the storage group is continually being exceeded or if the storage group is being impeded upon by other storage groups. Host I/O limits are not a method to maintain response time but allow users to control how much data is being driven to the array, which help service levels maintain consistent response-time performance.</p>

Claims	Exemplary Evidence of Infringement
	<p data-bbox="426 240 1650 300"><u>Figure 13 illustrates service levels as they apply to the response-time upper and lower limits and shows how host I/O limits relate to setting the maximum allowable throughput IOPS.</u></p>  <p data-bbox="426 911 1148 938">Figure 13 Service level management relative to host I/O limits</p> <p data-bbox="415 982 1455 1015"><u>Technical White Paper – Dell EMC PowerMax: Service Levels for PowerMaxOS</u></p>